

## ABSTRACT

The invention is in the filed of optical quantum information processing. This invention concerns the manipulation of single photon qubits in frequency modes, and in particular beamsplitter and a frequency half-wave plate for use in the frequency basis. The frequency beamsplitter comprises: An asymmetric two-path interferometer, reversible down to the quantum limit. A first partially transmitting mirror to split photons into first and second paths. A time delay element to introduce a differential time delay into the second path. And a second partially transmitting mirror to mix the two paths again to form two outputs. The half-wave plate utilizes two of the beam splitters.